Remarks

Prior to this Amendment, claims 1-30 were pending in this Application.

In the USPTO Action, the following points were asserted:

(1) Claims 1 and 16 were rejected under 35 U.S.C. 102(a) over U.S. Patent No. 6,525,731 ("Suits");

(2) Claims 2 and 17 were rejected under 35 U.S.C. 103(a) over Suits and U.S. Patent No. 6,570,578 ("Smirnov");

(3) Claims 3-7 and 18-22 were rejected under 35 U.S.C. 103(a) over Suits, Smirnov and U.S. Patent No. 6,538,654 ("Rose");

(4) Claims 8-13 and 23-28 were rejected under 35 U.S.C. 103(a) over Suits, Smirnov, and U.S. Patent No. 6,266,053 ("French"); and

(5) Claims 14, 15, 29, and 30 were rejected under 35 U.S.C. 103(a) over Suits, Smirnov, French and U.S. Patent No. 6,232,974 ("Horvitz").

The claims have been amended herein as follows: Claims 1-5 and 16-20 have been canceled without prejudice to re-filing such claims, whether in a Continuation application or otherwise. Claims 6, 8, 21 and 23 have been amended. New claims 31 and 32 have been added.

No admission of any kind, whether as to prior art or otherwise, is made hereby. Support for the amendment is found in the application as filed, and no new matter has been added.

The prior art rejections, and the differences between the amended claims and the cited references, will next be addressed in detail, following a discussion of the claimed invention.

The Claimed Invention:

The present invention relates to the field of computer image synthesis. As set forth in the specification and drawings, aspects of the present invention provide systems and techniques for enabling a network end user to view, on a suitable client device, a two-dimensional image that has been rendered from a three-dimensional scene by a server computer. Based upon customization inputs received from the end user, the server computer

modifies the underlying scene data and uses the modified scene data to re-render the image. The re-rendered image is then transmitted back to the end user.

In order to fully understand the present invention, one must understand the difference between "scene data" and an "image." "Scene data" is three-dimensional data including, among other things, geometrical models of the object(s) contained in the scene. An "image" is a two-dimensional rendering of the scene data, based upon a particular viewpoint and lighting source(s). Figuratively speaking, scene data can be thought of a collection of three-dimensional objects to be photographed, and an image can be thought of as a single photograph of those objects.

These aspects have particular significance in the context of modern networked computing architectures. More particularly, as noted in the Background of the Invention (p. 1 et seq. of the application as filed), Web pages are typically static in nature. In those limited situations (such as those using algorithms for three-dimensional viewing) in which non-static displays are possible, enormous quantities of data need to be accessed, retrieved and sent, which would be prohibitively slow or resource/bandwidth-intensive in the general case. Moreover, as stated in the Background section:

"Even if the bandwidth were sufficient to enable sufficient three-dimensional scene information to be retrieved within a reasonable amount of time to facilitate display of the scene with a more photo-realistic quality, in a number of situations it may be undesirable to transfer the information to the user. For example, if a manufacturer uses the Web site to provide information about its products for, for example, potential customers, it may not wish to make information sufficient to provide photo-realistic three-dimensional images available for retrieval, since information that is sufficiently detailed to generate such images may also be sufficiently detailed to provide a significant amount of design information that may be of interest to competitors. This is particularly the case if the information is sufficiently detailed to allow a user to modify or customize the scene. For example, if the manufacturer is an automobile manufacturer, it may be desirable to allow a user to not only view the automobile from user-selectable orientation, but also to modify or customize the scene, by, for example, changing the color and texture of various surfaces, changing the positions of light sources, enable the automobile to be displayed with doors, hood and/or trunk in an open position, and the like. The amount of information that would be necessary to allow a user to perform such

operations may require a significant amount of time to transfer. In addition, the amount of information that may be required may constitute a significant amount of the design information for the object(s) in the scene, which may be confidential."

Thus, as the Background states, "it will be desirable to maintain the three-dimensional scene information on the Web site and have the Web site render two-dimensional images in orientations and with modifications and customizations of the scene as specified by the user, and transmit the two dimensional image information to the user's browser for display. However, problems arise since not only will the Web site need to retrieve the information from databases on which the information is stored for transmission to the user's browser, but need also render the two- dimensional images from orientations and with modifications and customizations specified by the user. For example, if a number of users are accessing the Web site concurrently, the amount of processing power required to render the images in a reasonable amount of time can become quite large. In addition, problems can arise if a group of users are making use of the same scene, for whom customizations made by any of the users in the group are to be incorporated into the scene as used by all of the members of the group, since all of the customizations would need to be transmitted to all of the users and incorporated into their respective three-dimensional scenes."

The claimed invention provides a solution to the above-noted problems of the prior art. Among other advantages, the invention enables modifications and customizations in response to user requests, without requiring prohibitive amounts of bandwidth and processing resources, with the requirement of transmitting customizations to all users, and while enabling the information provider to maintain control over the amount of information provided.

In a system according to the present invention, an end user is shown a two-dimensional image of a three-dimensional scene. The user "customizes" the scene by making interactive inputs with respect to the *image* displayed on a local device. These inputs are then transmitted to the server, which makes corresponding changes to the scene data and then re-renders the two-dimensional image. The *re-rendered image* is then transmitted back to the end user.

Key features of the invention include, but are not limited, to the following:

1. Rendering and re-rendering is performed at the server level.

2. Scene data is not sent to the client. Thus, an end user can be provided with the ability to customize a scene without providing the end user with access to any proprietary or sensitive scene data.

3. At the client level, the end user works only with an image, using a suitable local interface. The end user never works with scene data. This feature may be useful, for example, in the case of a computer artist who may be familiar with the manipulation of a displayed image, but who may know nothing about the manipulation of scene data.

4. Because the client only works with image data and performs no rendering, the client device does not require a significant amount of computing power. For example, the client device can be a small, handheld PDA, "smart" phone, or like device.

5. Customizations are performed by customizing the underlying scene data. Therefore, the customizations are now centrally available to other users on the network.

6. Because customizations are performed on scene data at the server level, the information provider can limit, or otherwise control, the customizations that can be performed by an end user at the client level.

7. Further, end users and clients can be assigned to different classes, and can be granted varying levels of permissions with respect to customizations of scene data.

These and other aspects of the invention are reflected in the claims. For example, amended claim 6 is directed to a server connected into a network including at least one client and a communication link interconnecting the client and server. The server comprises an image rendering module configured to render, from three-dimensional scene data representing a scene, a two-dimensional image. An interface is configured to transmit the two-dimensional image over the communication link to the client. A user interaction control module configured to control interactions with the at least one client in connection with rendering of the image from the scene data.

Also in the amended claims, such as claim 6, the control interactions include requests from the at least one client. These requests include scene customization information requesting at least one customization to the scene. The user interaction control module is configured to enable the image rendering module to render an image of the scene as customized in relation to the customization information.

As will next be discussed in detail, the cited art does not teach or suggest the above described aspects of the present invention, and the claims are thus respectfully submitted to be patentable over the cited art.

Rejection of Claims 1 and 16 under 35 U.S.C. 102(a)

As noted above, Claims 1 and 16 were rejected under 35 U.S.C. 102(a) over Suits. Although the Applicant respectfully disagrees with this finding of the Action, the present Amendment, in order to move this long-pending application toward allowance, cancels claims 1 and 16 without prejudice to re-filing such claims, whether in a Continuation application or otherwise.

Rejection of Claims 2 and 17 under 35 U.S.C. 103(a)

Claims 2 and 17 were rejected under 35 U.S.C. 103(a) over Suits and Smirnov. Although the Applicant respectfully disagrees with this finding of the Action, the present Amendment, in order to move this long-pending application toward allowance, cancels claims 2 and 17 without prejudice to re-filing such claims, whether in a Continuation or otherwise.

Rejection of Claims 3-7 and 18-22 under 35 U.S.C. 103(a)

Claims 3-7 and 18-22 were rejected under 35 U.S.C. 103(a) over a combination of three references: Suits, Smirnov and Rose. Although the Applicant respectfully disagrees with this finding of the Action, the present Amendment, in order to move this long-pending application toward allowance, cancels claims 3-5 and 18-20 without prejudice to re-filing such claims, whether in a Continuation or otherwise.

The allowability of claims 6-7 and 21-22 over Suits, Smirnov and Rose will next be addressed.

Suits purports to disclose a system for providing interactive views of 3-dimensional models with surface properties. Suits asserts that the system provides "a compact representation of a 3D model and its surface features" and that it allegedly provides for efficiently viewing and interacting with the model using dynamically switched texture maps. The compact representation, asserts Suits, is beneficial for transmission of the model across a network as well as for local storage of the model in the computer memory. The dynamically

switched texture maps allow for more accurate surface details on the 3D model, as well as speedy interaction between a user and the 3D model.

Smirnov purports to provide a computer-based system that automates the production of so-called pass-images ("passes") from data defining 3-D scenes. For example, a "beauty pass" of a selected object shows the normal surface appearance without any background or other objects. A shadow pass shows only selected shadows and a highlight pass, only selected highlights. The passes allow pixel-processing to be done efficiently. The processed passes can then be combined ("composited") to form the finished image. In the past, these passes were produced by editing a copy of the 3-D scene for each pass and rendering the edited copy. Smirnov asserts that the invention automates the production of passes by filtering the 3-D scene through pre-specified pass definitions that override properties of the 3-D scenes. The results of filtering are rendered (rendering largely comprises the process of ray-tracing) to form the passes. The system stores numerous pass definitions. Each time the 3-D scene is edited, the passes can be produced automatically from the pass definitions. This automation of pass production also allows the passes to be used in the authoring environment by allowing a pass preview of the 3-D scene rendering.

Rose purports to disclose a system and method for facilitating the production, processing, and Internet distribution of 3D animated movies including 3D multipath movies. Rose asserts that a key reduction algorithm reduces the keyframes associated with the 3D movie to facilitate the streaming of the data over the Internet. An animation optimization and texture optimization algorithm allows the system to get statistical information of the portions of the 3D object which are invisible (outside the view frame), and whose animation and texture data may thus be safely removed. If the 3D object is within the view frame, the optimization algorithm gathers information about the distance and size of the 3D object and its associated texture data within the frame. The system and method further allows creation of various versions of the 3D object from a single production process. The various versions are tagged with an identifier identifying the target platforms and media platforms in which they are suitable for display. During playback, the correct version of the 3D object is selected for display based on the detected Internet bandwidth and/or CPU speed. To stream the 3D animation content over the Internet for real-time playback, the present system and method allows the data to be divided into an upfront file and various stream files. The upfront file is

downloaded prior to the playback of the movie. The stream files are streamed over the Internet and made available to the 3D engine in time for their use.

However, Claims 6-7 and 21-22, as amended, recite combinations of features not taught or suggested by the art of record, and that are patentable over the cited references, taken separately or in combination.

Specifically, the cited references, either separately or in combination, contain no teaching or suggestion of the entire combination of features recited by independent claims 6 and 21, including: a client-server architecture (and a computer program product enabling the client-server architecture), that enable a user to interactively select and customize a scene (i.e., update the underlying scene data) based upon a rendered image of the scene displayed on a client device, where the image has been rendered at the server level, and where *image data*, rather than *scene data*, has been transmitted to the client device. After a user has customized a scene at the client level, the customized scene is re-rendered at the server level.

The cited references are quite different and distinguishable. In Suits, a server sends model data to a client. The client then renders the model data to create an image to be displayed. As discussed above, in contrast, in the present invention, no rendering is performed at the client level.

In Smirnov, pre-specified pass data is used to create multiple image layers. The user cannot interactively customize the scene. Rather, the user's interaction is limited to compositing the rendered passes, without any customization of the underlying scene data and re-rendering. Again, this is in direct contrast to the claimed invention.

Rose describes client-side rendering, where the server's contribution consists of selecting which parts of the scene to send to the client.

Each of these approaches, of Suits, Smirnov and Rose, is fundamentally different from the approach set forth in amended claims 6 and 21. Claims 6 and 21 recite combinations of features that is neither taught nor suggested by the cited references, taken separately or in combination, and are thus respectfully asserted to be patentable over the references.

Claim 7 depends from claim 6, and claim 22 depends from claim 21, incorporating all of the limitations thereof and adding further limitations thereto. It is therefore asserted that claims 7 and 22 are allowable for the reasons advanced above in support of the patentability of claims 6 and 21, and further on the basis of the additional limitations therein.

For the above reasons, it is respectfully submitted that claims 6-7 and 21-22 are allowable over Suits, Smirnov and Rose.

Rejection of Claims 8-13 and 23-28 under 35 U.S.C. 103(a)

The Action rejected claims 8-13 and 23-28 under 35 U.S.C. 103(a) as being allegedly unpatentable over a combination of Suits, Smirnov, and French, citing, *inter alia*, cols. 9, 10 and 12 of Suits, cols. 3, 9, 10, 12 and 13 of Smirnov), and FIG. 2 and cols. 5, 6, 7 and 9 of French.

French purports to disclose a time inheritance scene graph technique, i.e., a technique for representing a visual scene as a directed acyclic graph of data and operators that generates a sequence of image frames over specified time intervals. The graph specifies temporal and spatial values for associated visual elements of the scene. Time is modeled in the inheritance properties explicitly defined within the scene graph hierarchy, by assigning temporal attributes to each media element. Branch nodes of the graph specify transforms for the temporal and spatial coordinate systems. To evaluate the appearance or behavior of the scene and in particular the global time values of particular elements at a given time instant, the graph is traversed in a direction from a root node down toward the leaf nodes, thereby causing temporal transformations specified along the branches of the graph to modify time parameters of the scene data at the nodes. Child nodes are preferably evaluated after being transformed, to determine the extent to which they contribute the data to the final scene. Temporal transformations may include translation operations that offset temporal event times; scaling operations that change the rate at which time passes; or clipping operations, that restrict the range of time parameters to exclude the evaluation of parts of the graph.

However, in the context of the claimed invention, French fails to add anything of significance to the other art of record. Specifically, French fails to teach or suggest, either singly, or in combination with the other art of record, a client-server architecture, and a computer program product enabling the client-server architecture, that allow a user to interactively select and customize a scene (i.e., update the underlying scene data) based upon a rendered image of the scene displayed on a client device, where the image has been rendered at the server level, and where *image data*, rather than *scene data* has been transmitted to the client device.

Claims 8 and 23 depend, respectively, from claims 6 and 21, incorporating all of the limitations thereof and adding further limitations thereto. It is thus asserted that claims 8 and 23 are allowable over the cited art for the reasons advanced above in support of the patentability of claims 6 and 21, and further on the basis of the added limitations.

Claims 9-13 and 24-28 depend, respectively, from claims 8 and 23, incorporating all of the limitations thereof and adding further limitations thereto. It is therefore asserted that claims 9-13 and 24-28 are allowable for the reasons advanced above in support of the patentability of claims 8 and 23 and further on the basis of the added limitations.

For the above reasons, it is respectfully asserted that claims 8-13 and 23-28, as amended, are allowable over Suits, Smirnov, and French.

Rejection of Claims 14, 15, 29, and 30 under 35 U.S.C. 103(a)

The Action rejected claims 14, 15, 29 and 30 under 35 U.S.C. 103(a) as being allegedly unpatentable over a combination of Suits, Smirnov, French and Horvitz et al. (U.S. 6,232,974), citing, *inter alia*, the Abstract and FIG. 9 of Horvitz.

Horvitz purports to disclose a decision-theoretic regulator that employs a method for allocating computational resources to components of media content to create the highest quality output for a budget of rendering resources. The components of the content represent parts of the content that have independent quality parameters that the regulator can vary to trade-off quality for computational savings. For example, in multimedia content, the components might be objects in a 3D graphics scene. Horvitz states that the method allocates computational resources by attempting to minimize the total expected cost of a rendering task. The method computes the raw error for a rendering action on a component and then maps the raw error to a perceived error based on empirical evidence of how users perceive errors in rendered output. The expected cost is computed from the perceived error or raw error by applying a model of attention that gives the probability that a user is focusing his or her attention on a component. The method minimizes the total expected cost by selecting a rendering action for each component that yields the lowest expected cost for a given rendering budget.

However, in the context of the claimed invention, Horvitz fails to add anything of significance to the other art of record. Specifically, Horvitz fails to teach or suggest, either

singly, or in combination with the other art of record, a client-server architecture, and a computer program product enabling the client-server architecture, that allow a user to interactively select and customize a scene (i.e., update the underlying scene data) based upon a rendered image of the scene displayed on a client device, where the image has been rendered at the server level, and where *image data*, rather than *scene data* has been transmitted to the client device.

Claims 14-15 and 29-30 depend, respectively, from claims 13 and 28, discussed above. It is therefore asserted that claims 14-15 and 29-30 are allowable for the reasons advanced above in support of the patentability of claims 13 and 28 and further on the basis of the added limitations.

For the above reasons, it is respectfully asserted that claims 14-16 and 29-30 are allowable over Suits, Smirnov, French, and Horvitz.

New Claims 31 and 32

New claims 31 and 32 are directed, respectively, to a server and computer program product for enabling such a server, for use in connection with a network including at least one client and a communication link interconnecting the client and server. The server includes an image rendering module configured to render, from three-dimensional scene data representing a scene, a two-dimensional image, an interface configured to transmit the two-dimensional image over the communication link to the client, and a user interaction control module configured to control interactions with said at least one client in connection with rendering of the image from the scene data, the image rendering module being configured to render images from scene data representing a plurality of scenes, the user interaction control module being configured to select scenes for which images are to be rendered.

As discussed above with respect to the other pending claims, the art of record fails to teach or suggest the claimed combination as recited in new claims 31 and 32. It is therefore respectfully asserted that new claims 31 and 32 are allowable.

Conclusion:

The Applicant believes the claims to be allowable, and allowance is therefore respectfully requested. If any questions remain, the Examiner is cordially invited to contact the undersigned.

Respectfully submitted,

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